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Corn Silage

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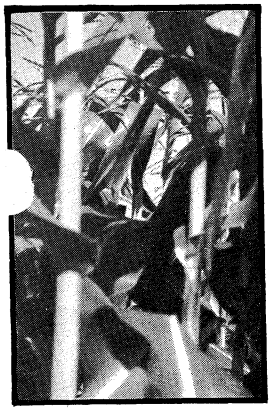

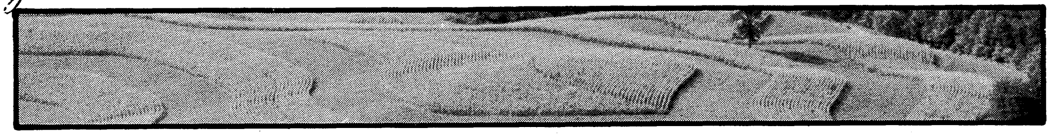

AGRONOMY GUIDE

PURDUE UNIVERSITY

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~~Corn~~ Silage, Corn

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Corn silage is a high energy roughage, and if properly balanced, it can replace a large proportion of corn in a feeding ration. High quality silage is very acceptable to ruminant animals; it is slightly brownish to dark green in color. If the silage should be dark brown, excessive heating has taken place. Corn silage should have a light pleasant smell with only a slight vinegar odor. Fruity or yeasty odors, a strong burnt odor, or the smell of rancid butter (butyric acid) indicate excessive heating and improper fermentation. If silage is not of acceptable quality, it is helpful to know what happens inside the silo.

The ensiled material is compressed by its own weight as ensilage accumulates and the cells respire. This may cause a flow of water or "bleeding" from the silo. Seepage will usually reach its peak on the fourth day after ensiling.

When corn is chopped and placed in the silo, it is still alive and breathing. This breathing by plant cells and micro-organisms forms carbon dioxide and heat by utilizing the trapped air. Therefore, an anaerobic condition is formed in the silo. The desirable bacteria will not start the fermentation process until plant respiration stops. Excess air prolongs respiration and plant cells use too much sugar and carbohydrates and, therefore, deplete food needed by the bacteria.

Acids, primarily acetic and lactic, keep silage from spoiling. These acids are produced by bacteria feeding on the available starches and simple sugars in the chopped corn. After the silo is filled, the desirable bacteria which make silage need three things to carry out the acid making process: (1) temperatures between 80° and 100° F., (2) available starches and sugars, (3) no air. Under these conditions, the bacteria begin to make desirable acids on about the fourth day after being ensiled. Fermentation will continue until enough acid is produced to stop bacterial action. This is at a pH of about 4.2 and occurs about three weeks after the silo is filled.

The production of corn silage has become a very important part of agriculture in the Midwest. Hybrid, planting date, population, row spacing, and fertilization are all important parts of this process.

<u>Hybrid</u> - A corn hybrid which is a top grain yielder will usually be a top silage producer. A variety which matures slightly later than

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one harvested for grain is often the most satisfactory for silage. Both hybrids will dent about the same time, but the later maturing variety will lose moisture more slowly than earlier varieties. This allows a longer period for filling silos with the silage corn nearer the proper ensiling stage.

Many special silage varieties are simply tall growing, long season hybrids. Exotic varieties such as high sugar-no ear corn are usually lower in nutritive value than normal grain varieties.

Planting date - Planting any adapted variety early will usually result in higher grain yields and decreased height. Harvesting early planted corn for silage is one of the easiest ways to increase the grain content of silage. The total dry matter will vary very little between corn planted from April 25th to May 20th, but grain content may vary considerably.

Plant Population - Corn to be used for silage may be seeded at the rate of 2,000 to 3,000 more plants per acre than corn to be harvested as grain. In most of Indiana, a population of 18,000 to 24,000 plants per acre is ideal for silage.

Reports of high nutrient yields when corn is planted at extremely thick rates of 30,000 to 100,000 stalks per acre have not been varified. Seeding rates which are too high push yields down, not up.

Row Spacing - Silage yields increase with narrow rows at about the same rate as grain yield increases. This increase can be from 0 to 10 percent. The major consideration before going to narrow row silage should be the costs of changing silage harvesting equipment.

Fertilizer - A 100 bushel corn crop harvested as silage removes more than twice as much nitrogen, three times as much phosphorus and ten times as much potassium than when the crop is harvested for grain. Removing the stalks accounts for the extra nutrient drain.

A 25 ton silage crop will remove approximately 200 pounds nitrogen, 35 pounds phosphorus and 145 pounds potassium. Do not reduce nitrogen applications on silage corn because of the fear of nitrate poisoning. Lower nitrogen applications will only lower corn and silage yields. In research at Purdue University up to 800 pounds of nitrogen per acre was used on corn. Fattening cattle were fed the silage, but they did not show any adverse health problems.

Grain content of silage - Contrary to popular belief, the ratio of bushels of grain per ton of silage is not a constant factor. On a per acre basis, bushels of grain increase much more rapidly than total silage yields. This is especially important in determining silage feeding values or costs of corn silage.

Table 1. Bushels of corn per ton of silage at different yield levels

Grain/A bushels	Grain/ton of silage bushels
89	5
117	6
124	6.2
131	6.9
152	7.5
160	8.1
180	12.0

Harvesting - It is important to harvest corn silage at the correct stage of maturity to insure high quality feed and top yields per acre.

Maximum silage yields per acre occur somewhere between the dent and glaze stage of the ear. At this stage, the ear has accumulated most of its potential feeding value, and the leaves and stalks have deteriorated very little. A good rule of thumb is to harvest corn for silage soon after the kernels are well dented but before the leaves turn brown and dry.

The digestibility of corn stalks and leaves slowly decreases from tasseling until the dent stage; then the feeding value rapidly decreases.

Fall temperatures influence the maturity rate of the grain. Corn maturity usually refers to the time when the ear has accumulated 100 percent of its dry matter production potential. In many years this potential is not achieved because of cool temperatures and cloudy weather. Table 2 lists a few guide lines, but variety and weather interactions may influence the result.

Table 2. Relationship of kernel moisture to yield potential

% water in kernels	Yield of grain as % of maximum
40	93.5
38	94.8
36	96.3
34	98.0
26	100.0
21	98.0

Harvesting when the grain is in the milk or early dough stage results in reduced feed nutrients. Often farmers harvest silage too early because they believe they are losing feed when they see undigested corn kernels in the manure. This is not true. Digestibility is as high with well dented kernels as with immature corn grain.

Corn silage which is cut late and has brown and dead leaves and shucks will usually make fair to good quality silage. Total acre production is less when harvested late. Dry matter yields begin to decrease after the kernels reach the late dent stage. Field losses are greater when silage is harvested late in the season. Some USDA research has shown field losses so high that the economics of this practice are questioned.

Damaged corn for silage - Frost, drought or hail-damaged corn can still be made into silage. Quality will not be as high as corn that has reached the full dent stage. Feeding value will depend upon the stage of development and how soon it was ensiled after damage occured. Silage from immature corn does not ferment in the same manner as more mature corn and, it often has a sour odor, and is more laxative when fed in large quantities.

Frosted corn has a low carotene content, and should be cut as soon as possible. It will dry out quickly and lose leaves in handling. Water may be added, especially near the top of the silo, if the silage does not pack well. If the corn is dry, keep the chopper knives sharp and chop as fine as possible.

Some common problems associated with corn silage are molds, silo gases and, to a lesser extent, high levels of nitrates.

Molds - Molds are common in silage, especially around silo doors and edges of bunker silos. White and gray molds, which are caused by exposing silage to air are seldom toxic to livestock, but intake is sometimes reduced.

Another type of mold causes silage to form lumps or small clumps. The outside of these clumps may have a white color but when broken, the center has a reddish hue. The mold organism involved is called MONASCUS. Cattle will usually eat silage containing this mold, and there have been no reported cases of toxicity.

A rapidly forming red type of mold that often appears on the face of silage between morning and evening feedings may be MONILLIA sitophilia or bakery mold. This is most commonly seen in the early spring as warmer temperatures occur. The mold spores were activated by the heat produced in the silage process and grow quickly when exposed to air. There are no known cases of toxicity due to bakery mold.

Silo gases - Three types of silo gases which are formed from nitrogen are especially dangerous to humans and animals. Two of these may be recognized by color and odor. Nitrogen dioxide is reddish brown and nitrogen tetroxide is yellow. Both have a sharp and irritating smell. Nitric oxide, however, is colorless and odorless.

Gases may develop from material grown on any soil type and under any environmental conditions. Never get into the silo at filling time without running the blower for about 15 minutes. Stay out of the silo for ten days to two weeks after filling.

These dangerous gases are heavier than air, so ventilate the silo feeding room by opening doors and windows. Keep children away from silo and feeding rooms during this period.

Nitrates - Nitrate poisoning in corn silage has been more myth than fact in the eastern portion of the corn belt. The possibility of nitrate poisoning from silage harvested under drought conditions has been questioned. This possibility does exist, but the chance of it occurring is small. The threat of nitrate poisoning is probably no greater in corn from droughty fields as from fields with plenty of moisture. As the soil moisture level becomes acute, nitrates move toward the soil surface and the corn roots go downward to reach moisture. Therefore, drought-stricken corn is often short of nitrates instead of over-supplied.

If heavy rains should occur, avoid harvesting silage from drought stricken fields for a few days. Excess nitrogen which is near the soil surface will leach downward and may be "picked up" by the corn root system. This could cause abnormally high nitrate levels in the plant, but it will soon subside after a few days.

Testing for nitrates in corn before harvesting is usually not recommended because nitrate levels in the plant change rapidly from day to day. Ensiling usually reduces nitrate levels, but if you suspect the silage has a high nitrate level, feed small amounts and closely observe animal performance at the start.

Silo capacity - Most tables used for estimating tons of silage in silos are based on silage harvested at 70 per cent moisture. Silo capacities bary little in terms of dry matter storage despite differences in moisture content of silage at filling time.

With large capacity silos and high speed filling methods, the distribution and packing of silage in silos has been sacrificed. Improper distribution and packing may cause excessive seepage, poor fermentation, and losses in storage capacity. One-half of the capacity of the silo which is 14 feet in diameter is in the outside two feet. If an over abundance of fluffy, light material is in this outside area, silo capacity may be reduced as much as 20 per cent.

It requires more power to chop silage short, but it is worth it. Silage chopped into .5 to .75 inch lengths will pack tighter and be more palatable to livestock.

Some hidden losses occur in all silos. Microorganisms which carry out the fermentation process require energy. In bunker silos, a 12 per cent loss in dry matter may occur. In hermetically sealed silos the loss may be as low as 5 to 7 per cent when corn silage is harvested in normal times. Conventional tower silos will usually have fermentation losses of approximately 7 to 8 per cent. Losses will be higher if silo doors are not properly fitted, if breathing systems in sealed structures are not operating correctly, or if silage material is not properly packed in bunker silos.

If silage is too dry, it may be necessary to add water in order to establish airtight conditions. As a rule of thumb, add four gallons of water per ton of silage for each one per cent desired rise in moisture content. Add this water as the silo is being filled. Water, which is added after the silo is filled, tends to seep down the silo walls and does not permeate the silage mass. This may cause leaching of silage nutrients, seepage which may break the air seal, and improper fermentation.

Trench or bunker silos should be well packed and covered with some kind of plastic or roofing felt. Covering can return $150.00 to $200.00 above labor and material costs on 20 by 100 foot bunker silo. The center of this type of silo should be mounded with silage to provide a crown or high point for rainwater drainage. The entire covering should be weighted with old tires, limestone, sawdust or some similar material.

Freezing does not impare the keeping quality of silage as long as the silage is not disturbed, but frozen silage may cause digestive disturbances when eaten by cattle. It is best to thaw out silage before feeding it.

If continous corn is used for silage, nitrogen and potassium deficiencies may develop. Larger amounts of these two elements must be applied if the corn is used for silage and not grain. Up to 150 pounds of nitrogen per acre may not be enough to prevent deficiency symptoms from appearing.

<u>Silage Additives</u> - Research has shown that additives or preservatives such as sodium metabisulfite, bisulfite, enzymes and antibiotics are of little value for increasing the feeding value of corn silage.

<u>Urea</u> added to corn silage does not preserve nor improve silage quality. No greater gains or milk production will result from the feeding of urea than from the feeding of a ration containing adequate protein. Results of urea and silage would be the same as feeding urea in the supplemental grain or protein rations. The primary benefit from adding urea to corn silage is that it may be a practical way of including it in the ration.

Silage with urea added is not as flexible in its uses as non-urea silage. For example, the University of Illinois recommends 20 pounds of urea per ton of silage for feeding 600 pound calves, 12 pounds per ton of silage for 800 pound yearlings and six pounds per ton of silage for mature pregnant cows or growing-out heifers.

If urea is used, it must be well mixed. Either slowly pour or meter the urea as the silage goes into the blower. Do not use urea in trench or bunker silos unless special mixing procedures are available.

Urea goes readily into solution with silage juices.

This would be an advantage in mixing, but if seepage or "bleeding" occurs, some urea is lost. The exact loss cannot be determined, and therefore maximum use of urea by the ruminant cannot be calculated.

<u>Limestone</u> added to corn silage may improve the feeding quality of the silage. Adding limestone at the rate of 20 pounds per ton of silage should theoretically act as a "buffer" and prevent the pH from dropping too quickly so that bacteria could produce more lactic and acetic acid. Research has shown varied results. Ohio State University research showed a slight improvement in feeding value in three out of six trials. Ten to 20 pounds of limestone per ton of silage did not give any benefit for dairy cattle in recent Iowa tests. Ohio workers got the same results using 10 pounds of limestone plus 10 pounds of urea per ton of corn silage as when they used 20 pounds of limestone per ton. Researchers have found about the same response with field grade limestone as with feed grade high calcium limestone.

Because limestone is low in cost and presents no toxicity problems for livestock, its use in corn silage is of little economic importance to the farmer, even if there is no increase in livestock productivity.